ton, that was nailed on, and there took ſome pieces from a Delft diſh without throwing it down, broke a quart mug, and from a four-ounce phial half full of oil cut off its empty half part without ſpilling a drop of the oil. The activity of the lightning was with abated violence to all other points of the compaſs; but not without ſome conſiderable degree of force; for it ſcraped the plaiſter off the wall in many different and diſtant places, both in the chamber and kitchen: and to the ſouth-weſt of the chamber, where was the window, broke many panes of glaſs, and tore the lead outwardly, without melting it; and broke two panes of the kitchen window, with its lead, ſituated under the chamber window. Both kitchen and chamber ſmelt as ſtrong of ſulphur ſome hours after, as if fumigated with brimſtone matches.

Sam. Cooper.

VIII. *Experiments concerning the* Encauſtic Painting *of the Ancients. In a Letter to the Right Honourable* George *Earl of* Macclesfield, *Preſident of the Royal Society, from Mr.* Joſiah Colebrooke, *F. R. S.*

My Lord,

Read Mar. 1. 1759. THE reſult of experiments (whatever the ſucceſs attending them may be), in philoſophical or mechanical inquiries, is not below the attention of the Royal Society.

The

The art of painting with burnt wax, (as it is called) hath long been loſt to the world; the uſe of it to painters, in the infancy of the art of painting, was of the utmoſt conſequence, drying oil being unknown, they had nothing to preſerve their colours entire from the injury of damps, and the heat of the ſun; a varniſh of ſome ſort was therefore neceſſary; but they being unacquainted with diſtilled ſpirits, could not, as we now do, diſſolve gums to make a tranſparent coat for their pictures; this invention therefore of burnt wax ſupplied that defect to them, and with this manner of painting, the chambers and other rooms in their houſes were furniſhed; this Pliny calls *encauſtum*, and we encauſtick painting.

The following experiments which I have the honour to lay before your Lordſhip and the Society, were occaſioned by the extract of a letter from the Abbé Mazeas, tranſlated by Dr. Parſons, and publiſhed in the ſecond part of the 49th volume of the *Philoſophical Tranſactions*, N° 100, concerning the antient method of painting with burnt wax, revived by Count Caylus.

The Count's method was,

Firſt, To rub the cloth or board deſigned for the picture ſimply over with bees-wax.

Secondly, To lay on the colours mixed with common water; but as the colours will not adhere to the wax, the whole picture was firſt rubbed over with * Spaniſh chalk, and then the colours are uſed.

* Spaniſh chalk is called by Dr. Parſons, in a note, Spaniſh white; this is a better kind of whitening than the common, and was the only

Thirdly, When the picture is dry, it is put near the fire, whereby the wax melts, and abſorbs all the colours.

EXPERIMENT I.

A piece of oak board was rubbed over with bees-wax, firſt againſt the grain of the wood, and then with the grain, to fill up all the pores that remained after it had been planed, and afterwards was rubbed over with as much dry Spaniſh white, as could be made to ſtick on it; this, on being painted (the colours mixed with water only), ſo clogged the pencil, and mixed ſo unequally with the ground, that it was impoſſible to make even an outline, but what was ſo much thicker in one part than another, that it would not bear ſo much as the name of painting; neither had it any appearance of a picture: However, to purſue the experiment, this was put at a diſtance from the fire, on the hearth, and the wax melted by ſlow degrees; but the Spaniſh white (tho' laid as ſmooth as ſo ſoft a body would admit, before the colour was laid on) yet on melting the wax into it, was not ſufficient to hide the grain of the wood, nor ſhew the colours by a proper whiteneſs of the ground, the wax in rubbing on the board, was unavoidably

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only white that had the name of Spaniſh annexed to it, that I could procure, tho' I enquired for it at moſt if not all the colour ſhops in town.

My friend Mr. Dacoſta ſhewed me a piece of Spaniſh chalk in his collection, which ſeemed more like a *cimolia* (tobacco pipe clay), and was the reaſon of my uſing that in one of the experiments.

thicker

thicker in ſome parts than other, and the Spaniſh white the ſame: on this I ſuſpected there muſt be ſome miſtake in the Spaniſh white and made the enquiry mentioned in the note * pag. 41.

To obviate the inequality of the ground in the firſt experiment;

Experiment II.

A piece of old wainſcoat (oak board) ¼ of an inch thick, which having been part of an old drawer, was not likely to ſhrink on being brought near the fire; this was ſmoothed with a fiſh-ſkin, made quite warm before the fire, and then with a bruſh dipped in white wax, melted in an earthen pipkin ſmeared all over, and applied to the fire again, that the wax might be equally thick on all parts of the board, a ground was laid (on the waxed board) with levigated chalk mixed with gum water (*viz.* Gum Arabick diſſolved in water): When it was dry, I painted it with a kind of landſkip, and purſuing the method laid down by Count Caylus, brought it gradually to the fire; I fixed the picture on a fire ſcreen which would preſerve the heat, and communicate it to the back part of the board, this was placed firſt at the diſtance of three feet from the fire, and brought forward by ſlow degrees till it came within one foot of the fire, which made the wax ſwell and bloat up the picture; but as the chalk did not abſorb the wax, the picture fell from the board and left it quite bare.

Experiment III.

I mixed three parts white wax, and one part white reſin, hoping the tenacity of the reſin might preſerve the picture. This was laid on a board heated, with a bruſh, as in the former; and the ground was chalk, prepared as before. This was placed horizontally on an ironing box, charged with an hot heater, ſhifting it from time to time, that the wax and reſin might penetrate the chalk; and hoping from this poſition, that the ground, bloated by melting the wax, would ſubſide into its proper place: but this, like the other, came from the board, and would not at all adhere.

Experiment IV.

Prepared chalk four drams, white wax, white reſin, of each a dram, burnt alabaſter half a dram, were all powdered together and ſifted, mixed with ſpirit of moloſſes inſtead of water, and put for a ground on a board ſmeared with wax and reſin, as in *Exp.* 3. This was alſo placed horizontally on a box-iron, as the former: the picture bliſtered, and was cracked all over; and tho' removed from the box-iron to an oven moderately heated (in the ſame horizontal poſition), it would not ſubſide, nor become ſmooth. When it was cold, I took an iron ſpatula made warm, and moved it gently over the ſurface of the picture, as if I were to ſpread a plaiſter. (This thought occurred, from the board being prepared with wax and reſin, and the ground having the ſame materials in its compoſition, the force of the ſpatula

ſpatula might make them unite.) This ſucceeded ſo well, as to reduce the ſurface to a tolerable degree of ſmoothneſs: but as the ground was broke off in many places, I repaired it with flake white, mixed up with the yolk of an egg and milk, and repainted it with moloſſes ſpirit (inſtead of water); and then put it into an oven with a moderate degree of heat. In this I found the colours fixed, but darker than when it was firſt painted; and it would bear being waſhed with water, not rubbed with a wet cloth.

Experiment V.

A board (that had been uſed in a former experiment) was ſmeared with wax and reſin, of each equal parts; was wetted with moloſſes ſpirit, to make whitening (or Spaniſh white) mixed with gum-water adhere. This, when dry, was ſcraped with a knife, to make it equally thick in all places. It was put into a warm oven, to make the varniſh incorporate partly with the whitening before it was painted; and it had only a ſmall degree of heat: water only was uſed to mix the colours. This was again put into an oven with a greater degree of heat; but it flaked off from the board: whether it might be owing to the board's having had a ſecond coat of varniſh (the firſt having been ſcraped and melted off), and that the unctuous parts of the wax had ſo entered its pores, that it would not retain a ſecond varniſh, I cannot tell.

Experiment VI.

Having miſcarried in theſe trials, I took a new board, planed ſmooth, but not poliſhed, either with a fiſh-

a fiſh-ſkin or ruſhes: I warmed it, and ſmeared it with wax only; then took *cimolia* (tobacco-pipe clay) diveſted of its ſand, by being diſſolved in water and poured off, leaving the coarſe heavy parts behind. After this was dried and powdered, I mixed it with a ſmall quantity of the yolk of an egg and cow's milk, and made a ground with this on the waxed board: this I was induced to try, by knowing that the yolk of an egg will diſſolve almoſt all unctuous ſubſtances, and make them incorporate with water; and I apprehended, that a ground, thus prepared, would adhere ſo much the more firmly to the board than the former had done, as to prevent its flaking off. The milk, I thought, might anſwer two purpoſes; firſt, uniting the ground with the wax; and ſecondly, by anſwering the end of ſize, or gum-water, and prevent the colours ſinking too deep into the ground, or running one into another. When the ground was near dry, I ſmoothed it with a pallat-knife, and waſhed with milk and egg where I had occaſion to make it ſmooth and even: when dry I painted it, mixing the colours with common water; this, on being placed horizontally in an oven, only warm enough to melt the wax, flaked from the board; but held ſo much better together than any of the former, that I paſted part of it on paper.

Experiment VII.

* Flake white mixed with egg and milk, crumbled all to pieces in the oven, put on the waxed board, as in the laſt experiment.

The bad ſucceſs which had attended all the former experiments, led me to conſider of what uſe the wax was in this kind of painting: and it occurred to me, that it was only as a varniſh to preſerve the colours from fading.

In order to try this,

Experiment VIII.

I took what the bricklayers call fine ſtuff, or putty †; to this I added a ſmall quantity of burnt alabaſter, to make it dry: this it ſoon did in the open air; but before I put on any colours, I dried it gently by the fire, leſt the colours ſhould run. When it was painted, I warmed it gradually by the fire (to prevent the ground from cracking), till it was very hot. I then took white wax three parts, white reſin one part, melted them in an earthen pipkin, and with a bruſh ſpread them all over the painted board, and kept it cloſe to the fire in a perpendicular ſituation, that what wax and reſin the plaiſter would not abſorb might drop off. When it was cold, I found the colours were not altered, either from the

* Flake white is the pureſt ſort of white lead.

† Putty is lime ſlacked, and, while warm, diſſolved in water, and ſtrained through a ſieve.

heat

heat of the fire, or paſſing the bruſh over them. I then rubbed it with a ſoft linen cloth, and thereby procured a kind of gloſs, which I afterwards increaſed by rubbing it with an hard bruſh; which was ſo far from ſcratching or leaving any marks on the picture, that it became more ſmooth and poliſhed by it.

After I had made all the foregoing experiments, in converſation with my honoured and learned friend Dr. Kidby, a fellow of this Society, I ſaid I had been trying to find out what the encauſtic painting of the ancients was. Upon which, he told me, that there was a paſſage in Vitruvius *de architectura* relative to that kind of painting; and was ſo good as to tranſcribe it for me from the 7th book, chap. 9. *De minii temperatura.* Vitruvius's words are; *At ſi quis ſubtilior fuerit, & voluerit expolitionem miniaceam ſuum colorem retinere, cum paries expolitus & aridus fuerit, tunc ceram punicam liquefactam igni, paulo oleo temperatam, ſeta inducat, deinde poſtea carbonibus in ferreo vaſe compoſitis, eam ceram apprime cum pariete, calefaciendo ſudare cogat, fiatque ut peræquetur, deinde cum candela linteiſque puris ſubigat, uti ſigna marmorea nuda curantur. Hæc autem* καυσις *græce dicitur. Ita obſtans ceræ punicæ lorica non patitur, nec lunæ ſplendorem, nec ſolis radios lambendo eripere ex his politionibus colorem.*

Which I thus tranſlate: " But if any one is more " wary, and would have the poliſhing [painting] " with vermilion hold its colour, when the wall is " painted and dry, let him take Carthaginian [Bar- " bary] wax, melted with a little oil, and rub it on " the wall with an hair pencil; and afterwards let " him

" him put live coals into an iron veſſel (chafing-diſh),
" and hold it cloſe to the wax, when the wall, by
" being heated, begins to ſweat; then let it be made
" ſmooth: afterwards let him rub it with a * candle
" and † clean linen rags, in the ſame manner as they
" do the naked marble ſtatues. This the Greeks call
" καυσις. The coat of Carthaginian wax (thus put
" on) is ſo ſtrong, that it neither ſuffers the moon
" by night, nor the ſun-beams by day, to deſtroy
" the colour."

Being ſatisfied, from this paſſage in Vitruvius, that the manner of uſing wax in *Exp.* 8. was right, I was now to find if the wax-varniſh, thus burnt into the picture, would bear waſhing: but here I was a little diſappointed; for rubbing one corner with a wet linen cloth, ſome of the colour came off; but waſhing with a ſoft hair pencil dipped in water, and letting it dry without wiping, the colours ſtood very well.

A board painted, as in *Exp.* 8, was hung in the moſt ſmoaky part of a chimney for a day, and ex-

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* This account of the method of poliſhing [painting] walls coloured with vermilion, gave me great ſatisfaction, as it proved the method I had taken in experiment 8. (which I had tried before I ſaw or knew of this paſſage in Vitruvius) was right. The uſe of the candle, as I apprehend, was to melt the wax on the walls, where by accident the bruſh had put on too much, or afford wax where the bruſh had not put on enough, or had left any part bare.

† The rubbing the wall with a linen cloth, while warm, will do very well, where there is only one colour to be preſerved; but where there are many, as in a landſchape, it will be apt to take off ſome, or render the colouring rather faint; which I found by wiping the wax off from a painting while it was hot.

poſed to the open air in a very foggy night. In the morning the board was ſeemingly wet through, and the water ran off the picture. This was ſuffered to dry without wiping; and the picture had not ſuffered at all from the ſmoke or the dew, either in the ground or the colours: but when dry, by rubbing it, firſt with a ſoft cloth, and afterwards with a bruſh, it recovered its former gloſs.

Suſpecting that ſome tallow might have been mixed with the white wax I had uſed, which might cauſe the colours to come off on being rubbed with a wet cloth, I took yellow wax which had been melted from the honeycomb in a private family, and conſequently not at all adulterated; to three parts of this I added one part reſin, and melted them together.

Experiment IX.

Spaniſh white, mixed with fiſh glew, was put for a ground on a board, and painted with water colours only. The board was made warm; and then the wax and reſin were put on with a bruſh, and kept cloſe to the fire till the picture had imbibed all the varniſh, and looked dry. When it was cold, I rubbed it firſt with a linen cloth, and then poliſhed it with an hard bruſh.

In theſe experiments I found great difficulties with regard to colours; many water colours being made from the juices of plants, have ſome degree of an acid in them; and theſe, when painted on an alkaline ground, as chalk, whitening, *cimolia*, and plaiſter, are, totally changed their colours, and from green became

became brown; which contributed much to make the experiments tedious. I would therefore adviſe the uſe of mineral or metallic colours for this ſort of painting, as moſt likely to preſerve their colour: for although I neutralized Spaniſh white, by fermenting it with vinegar, and afterwards waſhed it very well with water, it did not ſucceed to my wiſh.

Theſe experiments, and this paſſage from Vitruvius, will in ſome meaſure explain the obſcurity of part of that paſſage in Pliny which Dr. Parſons, in his learned comment on the encauſtic painting with wax, ſeems to deſpair of.

Ceris pingere was one ſpecies of encauſtic painting. Ενκαυστον, *inuſtum*, may be tranſlated, forced in by the means of fire, burnt in: for whatever is forced in by the help of fire can be rendered into Latin by no other ſignificant word, that I know of, but *inuſtum*. If this is allowed me, and I think I have the authority of Vitruvius (a writer in the Auguſtan age) for it, who ſeems to have wrote from his own knowlege, and not like Pliny, who copied from others much more than he knew himſelf, the difficulty with regard to this kind of painting is ſolved, and the encauſtic with burnt wax recovered to the public.

What he means by the next kind he mentions, *in ebore ceſtro id eſt viriculo*, I will not attempt to explain at preſent.

The ſhip painting is more eaſily accounted for: the practice being, in part, continued to this time; and is what is corruptly called breaming, for brenning or burning. This is done by reeds ſet on fire, and held under the ſide of a ſhip till it is quite hot;

then reſin, tallow, tar, and brimſtone, melted together, and put on with an hair bruſh while the planks remain hot, make ſuch a kind of paint as Pliny deſcribes; which, he ſays, *nec ſole, nec ſale, ventiſque corrumpitur*, as they were ignorant of the uſe of oil painting, they mixed that colour with the wax, *&c.* which they intended for each particular part of the ſhip, and put it on in the manner above deſcribed.

In the pictures painted for theſe experiments, and now laid before your Lordſhip and the Society, I hope neither the deſign of the landſchape, nor the execution of it, will be ſo much taken into conſideration as the varniſh (which was the thing wanted in this inquiry): and I think that will evince, that the encauſtic painting with burnt wax is fully reſtored by theſe experiments; and though not a new invention, yet having been loſt for ſo many ages, and now applied further, and to other purpoſes than it was by Vitruvius (who confined it to vermilion only), may almoſt amount to a new diſcovery, the uſe of it may be a means of preſerving many curious drawings to * poſterity: for this kind of painting may be on paper, cloth, or any other ſubſtance that will admit a ground to be laid on it. The proceſs is very ſimple, and is not attended with the diſagreeable ſmell unavoidable in oil painting, nor with ſome inconveniences inſeparable from that art; and as there is no ſubſtance we know, more durable than wax, it hath the greateſt probability of being laſting.

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* A bird painted by Mr. Edwards on paper, and the colours fixed by burned wax, was ſhewn to the Society, April 5th.

I aſk

I aſk pardon of your Lordſhip and the Society for taking up ſo much time as this paper hath required: but if it meets with your Lordſhip's and the Society's approbation, I may, in ſome future paper (when the neceſſary avocations of my profeſſion will allow me leiſure), lay before you ſome experiments, relating to colours which are not likely to change by being painted on any kind of ground.

As your Lordſhip's recommendation contributed much to make me a member of this learned body, I muſt beg your patronage of this communication; and am, with the greateſt reſpect,

Your Lordſhip's and the Society's

Moſt obedient humble Servant,

Budge-row,
February 27, 1759.

Joſiah Colebrooke.

IX. *A Letter concerning the ſucceſs of the preceding Experiments. In a Letter to the Right Honourable Lord* Charles Cavendiſh, *V. P. R. S. from Mr.* Joſiah Colebrooke, *F. R. S.*

My Lord,

Read April 5. 1759. IN a paper (I lately had the honour to lay before the Royal Society, on the encauſtic painting of the ancients) I mentioned an uſe which might be made of it to preſerve drawings. I have now the pleaſure of laying before your Lordſhip